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Wild Horse Reservoir
Elko County, Nevada

National Eutrophication Survey, Las Vegas, Nev

Prepared for

Environmental Monitoring and Support Lab, Las Vegas, Nev

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT

ON

WILD HORSE RESERVOIR

ELKO COUNTY

NEVADA

EPA REGION IX

WORKING PAPER No. 815

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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REPORT ON WILD HORSE RESERVOIR

ELKO COUNTY, NEVADA

EPA REGION IX

by

National Eutrophication Survey

Water and Land Quality Branch
Monitoring Operations Division
Environmental Monitoring & Support Laboratory
Las Vegas, Nevada

and

Special Studies Branch
Corvallis Environmental Research Laboratory
Corvallis, Oregon

Working Paper No. 815

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U.S. ENVIRONMENTAL PROTECTION AGENCY

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point source discharge reduction and nonpoint source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by the U.S. Environmental Protection Agency and to augment plans implementation by the States.

ACKNOWLEDGMENTS

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Nevada State Environmental Protection Service for professional involvement, to the Nevada National Guard for conducting the tributary sampling phase of the Survey, and to those Nevada wastewater treatment plant operators who provided effluent samples and flow data.

The staff of the Department of Conservation and Natural Resources, Division of Environmental Protection, State Environmental Protection Service provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports and provided critiques most useful in the preparation of this Working Paper Series.

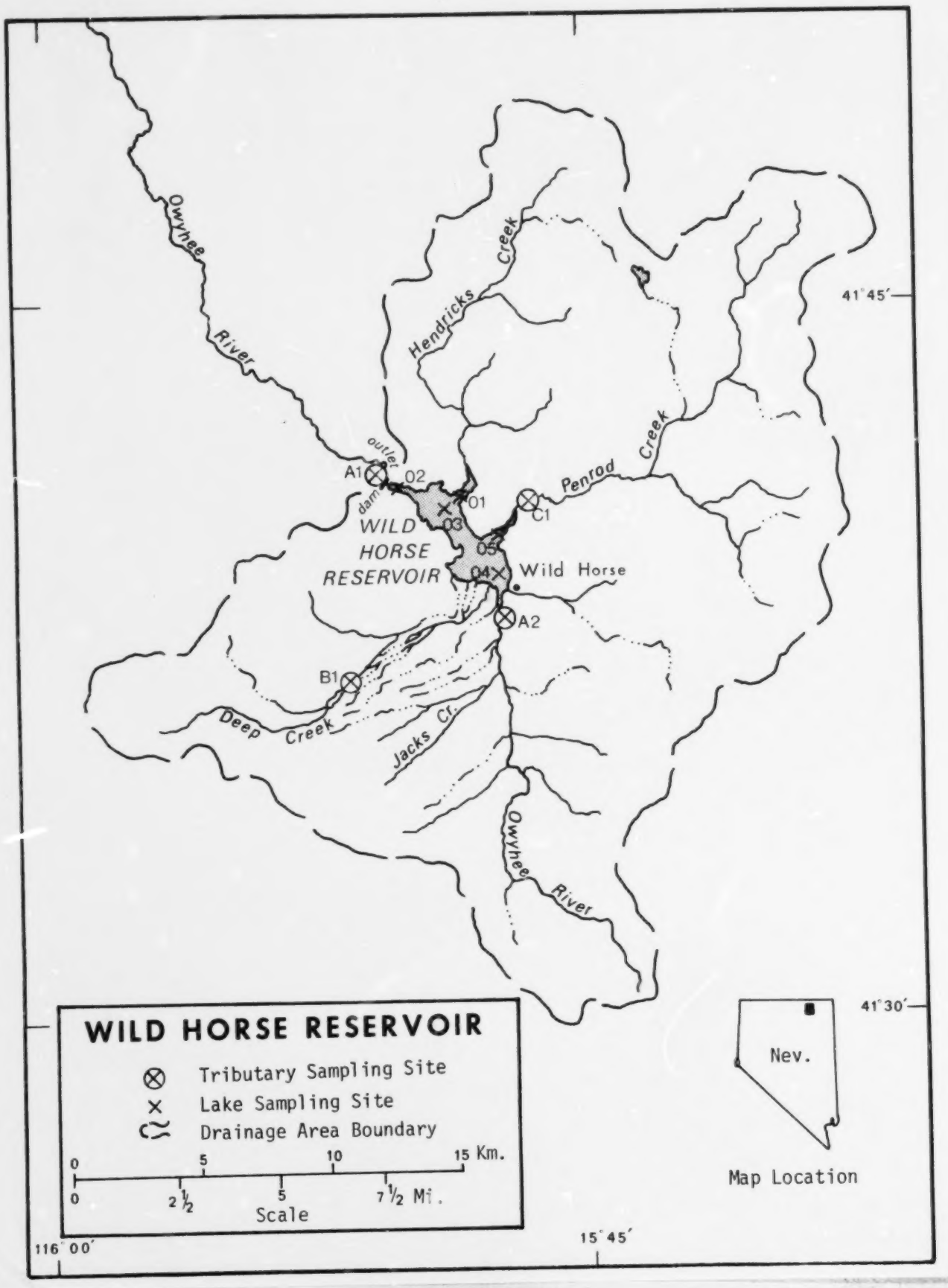
Major General Floyd L. Edsall, the Adjutant General of Nevada, and Project Officer Major Harold E. Roberts, who directed the volunteer efforts of the Nevada National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF NEVADA

LAKE NAME	COUNTY
Lake Mead	Clark (Mohave in Arizona)
Lahontan Reservoir	Lyon, Churchill
Rye Patch Reservoir	Pershing
Lake Tahoe	Washoe, Carson City, Douglas (Placer, El Dorado in CA)
Topaz Reservoir	Douglas (Mono in CA)
Upper Pahranagat Lake	Lincoln
Washoe Lake	Washoe
Wildhorse Reservoir	Elko
Wilson Reservoir	Elko
Walker Lake	Mineral


Owyhee River
Hendricks Creek
Penrod Creek
outlet
dam
A1
02
01
C1
WILD HORSE RESERVOIR
03
05
04
Wild Horse
A2
B1
Deep Creek
Jacks Cr.
Owyhee River
41°45′
41°30′
15°45′
116°00′
WILD HORSE RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 5 10 15 Km.
0 2½ 5 7½ Mi.
Scale
Nev.
Map Location

REPORT ON WILD HORSE RESERVOIR, NEVADA

STORET NO. 3209

I. CONCLUSIONS

A. Trophic Condition:*

Survey data indicate that Wild Horse Reservoir is eutrophic, i.e., nutrient rich and highly productive. Whether such nutrient enrichment is to be considered beneficial or deleterious is determined by its actual or potential impact upon designated beneficial water uses of the lake.

Chlorophyll a values in the lake ranged from 0.8 µg/l in November to 387.2 µg/l in August with a mean of 75.5 µg/l. Secchi disc visibility was low and the potential for primary productivity as measured by algal assay control yields was high. Marked depression of dissolved oxygen occurred in the hypolimnion during the August sampling. Of the 10 Nevada lakes sampled in 1975, 4 had higher median total phosphorus values (0.114 mg/l), 2 had higher median inorganic nitrogen levels (0.320 mg/l), and 3 had higher median orthophosphorus values (0.065 mg/l) than Wild Horse Reservoir.

*See Appendix E.

B. Rate-Limiting Nutrient:

Algal assay results indicate that Wild Horse Reservoir was limited by available nitrogen during the spring sampling (05/30/75) and by available phosphorus during the fall (11/06/75). The reservoir data suggest primary limitation by nitrogen during the three sampling dates.

C. Nutrient Controllability:

1. Point sources -

There were no known point sources impacting Wild Horse Reservoir during the sampling year.

It should be noted that substantial nutrient impact to the reservoir attributable to shoreline septic tanks may exist. Those U.S. Geological Survey (USGS) quadrangles used for determining the number of shoreline residences located within 100 meters of the lake were dated in the 1950's and 1960's. Thus the present number of septic tanks in the area is not known; neither has it been ascertained if those outside the 100 meter limit (U.S. EPA, 1975) do contribute nutrients to the lake as has been suggested (F. Luchetti, Personal communication). The Nevada Department of Human Resources (1975) reports the lack of adequate sanitary facilities serving visitors to the lake may result in localized enrichment problems. Additional study is recommended to obtain a more

accurate picture of the nutrient budget for Wild Horse Reservoir.

The present phosphorus loading of 0.67 g $P/m^2/yr$ is twice that proposed by Vollenweider (1975) as "eutrophic" for a lake of such volume and hydraulic retention time. Examination of surrounding land use practices may provide answers to reduction of nonpoint contributions to the lake.

2. Nonpoint sources -

The Owyhee River contributed 30.6% of the total phosphorus load to Wild Horse Reservoir during the sampling year, Deep Creek contributed 6.7%, and minor tributaries and immediate drainage contributed 60.1%. The Nevada Department of Human Resources (1975) lists agricultrual runoff as one of the main sources of nonpoint enrichment in the Wild Horse Reservoir watershed.

The nutrient export rates of Owyhee River and Deep Creek (Section IV-D) were substantially greater during the sampling year than the inflowing tributary to nearby Wilson Reservoir*.

*See Working Paper No. 816, "Report on Wilson Reservoir".

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS

Lake and drainage basin characteristics are itemized below. Lake morphometry data were provided by James B. Williams, Jr. (personal communication). Tributary flow data were provided by the Nevada District Office of the U.S. Geological Survey (USGS). Outlet drainage area includes the lake surface area. Mean hydraulic retention time was obtained by dividing the lake volume by mean flow of the outlet. Precipitation values are estimated by methods as outlined in National Eutrophication Survey (NES) Working Paper No. 175. A table of metric/English conversions is included as Appendix A.

A. Lake Morphometry:

1. Surface area: 12.14 km^2.
2. Mean depth: 7.3 meters.
3. Maximum depth: 26.5 meters.
4. Volume: 88.811 x 10^6 m^3.
5. Mean hydraulic retention time: 894 days (2.4 yrs).

B. Tributary and Outlet:
(See Appendix B for flow data)

1. Tributaries -

Name	Drainage area (km^2)	Mean Flow (m^3/sec)
A-2 Owyhee River	145.0	0.54
B-1 Deep Creek	42.5	0.20
Minor tributaries and immediate drainage -	342.7	0.47
Total	530.2	1.21
2. Outlet - A-1 Owyhee River	541.3	1.15

C. Precipitation:

1. Year of sampling: 39.1 cm.
2. Mean annual: 37.4 cm.

III. LAKE WATER QUALITY SUMMARY

Wild Horse Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from five stations on the lake and from a number of depths at each station (see map, page v). During the last two visits, depth-integrated samples for chlorophyll a analysis were collected from each station and on each sampling date samples for phytoplankton identification and enumeration were taken. During the first and last visits, 18.9-liter depth-integrated samples were composited for algal assays. Maximum depths sampled were 11.3 meters at Station 01, 21.3 meters at Station 02, 19.8 meters at Station 03, 4.6 meters at Station 04, and 7.6 meters at Station 05. For a more detailed explanation of NES methods, see NES Working Paper No. 175.

The results obtained are presented in full in Appendix C and are summarized in III-A for waters at the surface and at the maximum depth for each site. Results of the phytoplankton counts and chlorophyll a determinations are included in III-B. Results of the limiting nutrient study are presented in III-C.

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PHYSICAL AND CHEMICAL CHARACTERISTICS

PARAMETER	(5/30/75) N*	S*** = 5 RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(8/ 1/75) N*	S*** = 5 RANGE	MEDIAN	MAX DEPTH RANGE (METERS)	(11/ 6/75) N*	S*** = 5 RANGE	MEDIAN	MAX DEPTH RANGE (METERS)
TEMPERATURE (DEG CENT)												
0.-1.5 M DEPTH	7	7.0- 10.0	8.5	0.0- 0.9	5	20.5- 23.0	22.4	0.0- 0.0	10	5.3- 6.0	5.8	0.0- 1.5
MAX DEPTH**	5	2.8- 8.5	5.0	4.3- 21.3	5	7.5- 16.5	11.0	1.8- 19.2	5	5.4- 6.0	5.4	4.6- 18.9
DISSOLVED OXYGEN (MG/L)												
0.-1.5 M DEPTH	6	5.4- 11.5	11.4	0.0- 0.9	5	6.2- 11.0	10.6	0.0- 0.0	10	6.8- 8.8	7.2	0.0- 1.5
MAX DEPTH**	4	8.3- 10.4	8.9	4.3- 19.8	5	0.8- 8.2	1.0	1.8- 19.2	5	6.6- 7.6	7.0	4.6- 18.9
CONDUCTIVITY (UMHOS)												
0.-1.5 M DEPTH	7	78.- 100.	100.	0.0- 0.9	5	12.- 13.	13.	0.0- 0.0	10	174.- 184.	178.	0.0- 1.5
MAX DEPTH**	5	90.- 100.	100.	4.3- 21.3	5	10.- 12.	11.	1.8- 19.2	5	178.- 184.	179.	4.6- 18.9
PH (STANDARD UNITS)												
0.-1.5 M DEPTH	7	8.6- 11.1	9.4	0.0- 0.9	5	8.3- 9.1	8.7	0.0- 0.0	10	7.2- 7.9	7.5	0.0- 1.5
MAX DEPTH**	5	7.7- 9.1	8.0	4.3- 21.3	5	7.4- 9.3	7.9	1.8- 19.2	5	7.4- 7.6	7.5	4.6- 18.9
TOTAL ALKALINITY (MG/L)												
0.-1.5 M DEPTH	6	0.- 77.	65.	0.0- 0.9	5	76.- 80.	79.	0.0- 0.0	10	73.- 80.	76.	0.0- 1.5
MAX DEPTH**	4	70.- 81.	74.	4.3- 19.8	5	72.- 82.	78.	1.8- 19.2	5	72.- 85.	77.	4.6- 18.9
TOTAL P (MG/L)												
0.-1.5 M DEPTH	6	0.108-0.130	0.114	0.0- 0.9	5	0.064-0.514	0.332	0.0- 0.0	10	0.108-0.137	0.111	0.0- 1.5
MAX DEPTH**	4	0.100-0.202	0.122	4.3- 19.8	5	0.068-0.284	0.228	1.8- 19.2	5	0.105-0.134	0.114	4.6- 18.9
DISSOLVED ORTHO P (MG/L)												
0.-1.5 M DEPTH	6	0.035-0.069	0.055	0.0- 0.9	5	0.022-0.224	0.060	0.0- 0.0	10	0.065-0.082	0.069	0.0- 1.5
MAX DEPTH**	4	0.028-0.067	0.050	4.3- 19.8	5	0.021-0.155	0.114	1.8- 19.2	5	0.066-0.082	0.070	4.6- 18.9
NO2+NO3 (MG/L)												
0.-1.5 M DEPTH	6	0.080-0.240	0.170	0.0- 0.9	5	0.020-0.040	0.030	0.0- 0.0	10	0.210-0.300	0.225	0.0- 1.5
MAX DEPTH**	4	0.060-0.280	0.205	4.3- 19.8	5	0.020-0.230	0.160	1.8- 19.2	5	0.220-0.240	0.240	4.6- 18.9
AMMONIA (MG/L)												
0.-1.5 M DEPTH	6	0.040-0.150	0.060	0.0- 0.9	5	0.040-0.100	0.060	0.0- 0.0	10	0.200-0.290	0.220	0.0- 1.5
MAX DEPTH**	4	0.050-0.100	0.075	4.3- 19.8	5	0.040-0.740	0.260	1.8- 19.2	5	0.220-0.260	0.230	4.6- 18.9
KJELDAHL N (MG/L)												
0.-1.5 M DEPTH	6	0.600-1.300	0.750	0.0- 0.9	5	0.800-3.200	2.400	0.0- 0.0	10	0.700-0.800	0.700	0.0- 1.5
MAX DEPTH**	4	0.400-0.800	0.650	4.3- 19.8	5	0.800-1.000	0.900	1.8- 19.2	5	0.700-0.800	0.800	4.6- 18.9
SECCHI DISC (METERS)												
	5	0.4- 0.4	0.4		5	0.2- 0.2	0.2		0	***** - *****	*****	

* N = NO. OF SAMPLES
** MAXIMUM DEPTH SAMPLED AT EACH SITE
*** S = NO. OF SITES SAMPLED ON THIS DATE

B. Biological Characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units Per ml
05/30/75	1. Centric diatom	8,958
	2. Fragilaria	444
	3. Cryptomonas	121
	4. Phormidium	121
	5. Lyngbya	81
	Other genera	80
	Total	9,805
08/01/75	1. Gloeotrichia	541
	2. Fragilaria	496
	3. Aphanizomenon	270
	4. Aphanothece	90
	5. Cocconeis	90
	Other genera	225
	Total	1,712
11/06/75	1. Chroomonas?	196
	2. Aphanizomenon	33
	3. Trachelomonas	33
	4. Schroederia	33
	Other genera	---
	Total	295

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
08/01/75	01	10.0
	02	20.3
	03	13.6
	04	309.7
	05	387.2
11/06/75	01	0.8
	02	3.5
	03	3.5
	04	2.5
	05	4.2

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum Yield (mg/l-dry wt.)
a. 05/30/75			
Control	0.045	0.135	7.7
0.05 P	0.095	0.135	8.4
0.05 P + 1.0 N	0.095	1.135	34.9
1.00 N	0.045	1.135	19.9
b. 11/06/75	Stations 01-03		
Control	0.060	0.390	8.4
0.05 P	0.110	0.390	10.9
0.05 P + 1.0 N	0.110	1.390	9.7
1.00 N	0.060	1.390	7.4
	Stations 04-05		
Control	0.075	0.520	15.4
0.05 P	0.125	0.520	18.6
0.05 P + 1.0 N	0.125	1.520	16.7
1.00 N	0.075	1.520	12.3

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum*, indicate that the potential for primary productivity in Wild Horse Reservoir was high at both sample collection times (05/30/75, 11/06/75). In the May assay, a significant increase in yield over that of the control occurred when nitrogen was added alone and in combination with phosphorus, indicating nitrogen limitation. Spikes of phosphorus alone resulted in a yield which was not significantly greater than that of the control. In the November assays, the slight increases in growth over control yields produced by the addition of phosphorus suggest phosphorus limitation.

The mean inorganic nitrogen to orthophosphorus ratios (N/P) in the lake data of less than 7/1 on all three sampling occasions suggest primary limitation by nitrogen (a mean N/P ratio of 14/1 or greater generally reflects phosphorus limitation).

*For further information regarding the algal assay test procedure and selection of test organisms, see U.S. EPA (1971).

IV. NUTRIENT LOADINGS
(See Appendix D for data)

For the determination of nutrient loadings, the Nevada National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of April, May and June when two samples were collected. Sampling was begun in November 1974, and was completed in October 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Nevada District Office of the USGS for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a USGS computer program for calculating stream loadings. Nutrient loads indicated for tributaries are those measured minus known point source loads, if any.

Nutrient loadings for unsampled "minor tributaries and immediate drainage" ("ZZ" of USGS) were estimated by using the mean annual nutrient loads, in $kg/km^2/year$, in Owyhee River and Deep Creek at Stations A-2 and B-2 and multiplying the means by the ZZ area in km^2.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Owyhee River	2,445	30.6
B-1 Deep Creek	530	6.7
b. Minor tributaries and immediate drainage (nonpoint load) -	4,800	60.1
c. Known municipal STP's - None		
d. Septic tanks - None known		
e. Known industrial - None		
f. Direct precipitation* -	210	2.6
Total	7,985	100.0%

2. Outlets - A-1 Owyhee River 10,415

3. Net annual P export** - 2,430

*Estimated (See NES Working Paper No. 175).
**Export probably due to unknown sources and/or sampling error.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (nonpoint load) -		
A-2 Owyhee River	37,190	27.9
B-1 Deep Creek	7,775	5.8
b. Minor tributaries and immediate drainage (nonpoint load) -	75,395	56.5
c. Known municipal STP's - None		
d. Septic tanks - None known		
e. Known industrial - None		
f. Direct precipitation* -	13,105	9.8
Total	133,465	100.0%

2. Outputs - A-2 Owyhee River 61,640

3. Net annual N accumulation - 71,825

*Estimated (See NES Working Paper No. 175).

D. Mean Annual Nonpoint Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Owyhee River	17	256
Deep Creek	12	183

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P (mg/l)	Mean Total N (mg/l)
C-1 Penrod Creek	0.087	1.000

F. Yearly Loadings:

In the following table, the existing phosphorus annual loading is compared to the relationship proposed by Vollenweider (1975). Essentially, his "eutrophic" loading is that at which the receiving waters would become eutrophic or remain eutrophic; his "oligotrophic" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A "mesotrophic" loading would be considered one between "eutrophic" and "oligotrophic".

Note that Vollenweider's model may not apply to lakes with short hydraulic retention times or in which light penetration is severely restricted by high concentrations of suspended solids in the surface waters.

	Total Yearly Phosphorus Loading ($g/m^2/yr$)
Estimated loading for Wild Horse Reservoir	0.66
Vollenweider's "eutrophic" loading	0.34
Vollenweider's "oligotrophic" loading	0.17

V. LITERATURE REVIEWED

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VI. APPENDICES

APPENDIX A

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = cres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 03837 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 - lbs/square mile

APPENDIX B

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR NEVADA 1/21/77

LAKE CODE 3209 WILD HORSE RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 541.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
3209A1	541.3	0.057	0.227	0.311	2.039	2.577	2.265	2.322	2.322	1.274	0.255	0.057	0.028	1
3209A2	145.0	0.255	0.255	0.453	1.161	1.869	1.529	0.425	0.113	0.085	0.113	0.113	0.142	0
320981	42.5	0.085	0.085	0.170	0.425	0.680	0.566	0.142	0.057	0.028	0.042	0.042	0.057	0
3209ZZ	354.8	0.227	0.227	0.396	0.991	1.614	1.303	0.368	0.113	0.085	0.113	0.113	0.113	0

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 541.3
SUM OF SUB-DRAINAGE AREAS = 542.3
TOTAL FLOW IN = 14.55
TOTAL FLOW OUT = 13.73

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3209A1	11	74	0.210	24	0.201				
	12	74	0.028	13	0.028				
	1	75	0.023	18	0.023				
	2	75	0.020	22	0.020				
	3	75	0.025	22	0.028				
	4	75	1.472	13	0.680	28	2.407		
	5	75	10.591	12	2.577	24	15.914		
	6	75	5.720	7	8.495	22	4.276		
	7	75	1.189	20	0.122				
	8	75	2.095	17	2.379				
	9	75	1.388	13	1.671				
	10	75	2.124	12	1.529				
3209A2	11	74	0.057	24	0.057				
	12	74	0.051	13	0.042				
	1	75	0.051	18	0.051				
	2	75	0.071	22	0.068				
	3	75	0.113	22	0.127				
	4	75	0.255	13	0.255	28	0.566		
	5	75	0.850	12	0.991	24	0.850		
	6	75	0.198	7	0.283	22	0.113		
	7	75	0.085	20	0.062				
	8	75	0.028	17	0.023				
	9	75	0.031	13	0.031				
	10	75	0.034	12	0.034				

B-4

TRIBUTARY FLOW INFORMATION FOR NEVADA 1/21/77

LAKE CODE 3209 WILD HORSE RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
320981	11	74	0.0	24	0.0				
	12	74	0.011	13	0.003				
	1	75	0.028	18	0.037				
	2	75	0.042	22	0.040				
	3	75	0.085	22	0.142				
	4	75	0.283	13	0.255	28	0.566		
	5	75	1.982	12	2.265	24	2.124		
	6	75	0.991	7	1.557	22	0.708		
	7	75	0.113	20	0.085				
	8	75	0.003	17	0.003				
	9	75	0.0	13	0.0				
	10	75	0.0	9	0.0				

APPENDIX C

PHYSICAL AND CHEMICAL DATA

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320901
41 41 02.0 115 48 16.0 3
WILDHORSE RESERVOIR
32007 NEVADA

/TYPA/AMBNT/LAKE

11EPALES 751216 04001002
0035 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/30	10 00	0000	8.0	8.8	17	78	9.80	57	0.090	1.300	0.180	0.069
	10 00	0003	7.0	8.4		83	9.00	60	0.070	0.600	0.200	0.054
	10 00	0006	6.5	10.2		85	8.80	65	0.080	0.600	0.210	0.054
	10 00	0010	6.0			86	8.60					
	10 00	0016	6.0	7.2		86	7.80	63	0.100	0.600	0.240	0.058
	10 00	0023	5.5			92	8.00					
	10 00	0035	5.0	9.3		90	7.70	72	0.090	0.600	0.250	0.058
75/08/01	16 07	0000	23.0	11.0	6	13	8.70	79	0.060	2.400	0.030	0.076
	16 07	0009	18.0	11.6		12	8.65	77	0.050	1.300	0.020	0.018
	16 07	0024	15.8	5.4		12	8.00	79	0.120	1.100	0.170	0.124
	16 07	0037	11.0	0.8		11	7.75	72	0.120	0.800	0.180	0.117
75/11/06	13 35	0000	5.8	7.2		177	7.50	75	0.250	0.700	0.230	0.069
	13 35	0005	5.8	7.4		180	7.55	75	0.260	0.800	0.240	0.070
	13 35	0015	5.8	7.0		181	7.50	74	0.240	0.700	0.240	0.068
	13 35	0030	5.7	7.0		179	7.55	75	0.260	0.800	0.240	0.078

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/30	10 00	0000	0.130		
	10 00	0003	0.108		
	10 00	0006	0.114		
	10 00	0016	0.117		
	10 00	0035	0.120		
75/08/01	16 07	0000	0.332	10.0	
	16 07	0009	0.201		
	16 07	0024	0.282		
	16 07	0037	0.228		
75/11/06	13 35	0000	0.109	0.8	
	13 35	0005	0.115		
	13 35	0015	0.115		
	13 35	0030	0.114		

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320902
41 41 12.0 115 50 23.0 3
WILDHORSE RESERVOIR
32007 NEVADA

/TYPA/AMBNT/LAKE

11EPALES 751216 04001002
0070 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/30	11	00 0000	8.0	11.5	15	100	8.60	0R	0.150	0.600	0.240	0.057
	11	00 0006	7.0	7.9		100	8.60	63	0.060	0.600	0.230	0.054
	11	00 0010	6.0	9.6		100	8.40	66	0.070	0.500	0.240	0.055
	11	00 0016	5.4	9.1		100	7.40	74	0.080	0.600	0.240	0.054
	11	00 0033	4.8			100	8.20					
	11	00 0050	3.9	4.0		100	8.20	76	0.120	0.800	0.250	0.043
	11	00 0070	2.8			100	8.00					
75/08/01	15	07 0000	21.0	6.2	6	12	8.30	80	0.060	1.000	0.040	0.036
	15	07 0012	18.3	6.0		12	8.40	77	0.050	0.700	0.040	0.033
	15	07 0027	16.3	2.6		12	7.80	76	0.050	0.600	0.170	0.064
	15	07 0040	10.0	0.4		10	7.50	77	0.180	0.700	0.210	0.134
	15	07 0063	7.8	1.0		10	7.40	78	0.280	1.000	0.160	0.114
75/11/06	14	15 0000	5.9	7.2		177	7.60	76	0.220	0.700	0.220	0.069
	14	15 0005	5.9	6.8		180	7.60	80	0.240	0.700	0.220	0.069
	14	15 0015	5.8	6.6		181	7.55	82	0.240	0.700	0.230	0.067
	14	15 0035	5.5	6.6		180	7.50	81	0.220	0.700	0.240	0.066
	14	15 0062	5.4	6.6		181	7.50	85	0.230	0.800	0.240	0.067

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/30	11	00 0000	0.116		
	11	00 0006	0.113		
	11	00 0010	0.116		
	11	00 0016	0.144		
	11	00 0050	0.235		
75/08/01	15	07 0000	0.097	20.3	
	15	07 0012	0.061		
	15	07 0027	0.094		
	15	07 0040	0.196		
	15	07 0063	0.253		
75/11/06	14	15 0000	0.108	3.5	
	14	15 0005	0.108		
	14	15 0015	0.104		
	14	15 0035	0.118		
	14	15 0062	0.125		

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320903
41 40 48.0 115 49 03.0 3
WILDHORSE RESERVOIR
32007 NEVADA

/TYPA/AMBNT/LAKE

11EPALES 751216 04001002
0065 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/30	12 00	0000	8.5	11.5	15	100	9.09	70	0.050	0.900	0.160	0.058
	12 00	0006	7.9	9.2		100	8.20	74	0.050	0.600	0.190	0.050
	12 00	0010	6.5	12.8		100	7.90	73	0.050	0.500	0.210	0.057
	12 00	0016	5.4	9.5		96	8.40	75	0.050	0.700	0.210	0.056
	12 00	0033	4.8	9.8		94	8.40	80	0.110	0.600	0.270	0.066
	12 00	0045	4.0			94	8.30					
	12 00	0065	3.5	8.6		94	7.70	81	0.100	0.700	0.280	0.067
75/08/01	15 40	0000	20.5	8.0	6	13	8.85	79	0.040	0.800	0.030	0.022
	15 40	0012	17.8	6.2		11	8.65	80	0.060	0.800	0.030	0.020
	15 40	0024	15.4	2.0		12	8.00	77	0.060	0.700	0.190	0.072
	15 40	0040	10.5	1.8		10	7.60	75	0.120	0.700	0.260	0.069
	15 40	0060	7.5	1.0		11	7.95	82	0.260	0.900	0.150	0.155
75/11/06	14 00	0000	5.8	7.4		177	7.60	80	0.220	0.700	0.220	0.068
	14 00	0005	5.8	7.4		174	7.90	74	0.220	0.700	0.210	0.068
	14 00	0015	5.8	7.0		180	7.60	75	0.210	0.700	0.210	0.067
	14 00	0050	5.4	7.0		178	7.60	72	0.220	0.700	0.240	0.066

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/30	12 00	0000	0.127		
	12 00	0006	0.113		
	12 00	0010	0.113		
	12 00	0016	0.116		
	12 00	0033	0.127		
	12 00	0065	0.125		
75/08/01	15 40	0000	0.069	13.6	
	15 40	0012	0.051		
	15 40	0024	0.114		
	15 40	0040	0.141		
	15 40	0060	0.284		
75/11/06	14 00	0000	0.110	3.5	
	14 00	0005	0.108		
	14 00	0015	0.111		
	14 00	0050	0.105		

4-2

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320904
41 39 23.0 115 47 41.0 3
WILDHORSE RESERVOIR
32007 NEVADA

/TYPA/AMBNT/LAKE

11EPALES 751216 04001002
0014 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/30	13 00	0000	10.0	11.4	14	100	11.09	77	0.050	0.800	0.080	0.035
	13 00	0006	9.9	9.4		100	10.89	76	0.040	0.700	0.060	0.031
	13 00	0010	9.9			100	10.40					
	13 00	0014	8.5	10.4		100	9.00	70	0.050	0.400	0.060	0.028
75/08/01	13 42	0000	22.5	10.6	6	13	9.10	76	0.100	2.600	0.020K	0.060
	13 42	0006	16.5	8.2		12	9.30	79	0.040	0.800	0.020K	0.021
75/11/06	13 00	0000	5.3	8.8		179	7.20	73	0.200	0.700	0.220	0.065
	13 00	0005	5.4	7.2		177	7.35	74	0.200	0.800	0.230	0.069
	13 00	0015	5.4	7.6		179	7.40	77	0.220	0.800	0.230	0.070

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/30	13 00	0000	0.112		
	13 00	0006	0.106		
	13 00	0014	0.100		
75/08/01	13 42	0000	0.357	309.7	
	13 42	0006	0.068		
75/11/06	13 00	0000	0.112	2.5	
	13 00	0005	0.113		
	13 00	0015	0.113		

K VALUE KNOWN TO BE LESS THAN INDICATED

STORET RETRIEVAL DATE 77/01/26
NATL EUTROPHICATION SURVEY
EPA-LAS VEGAS

320905
41 40 14.0 115 47 18.0 3
WILDHORSE RESERVOIR
32007 NEVADA

/TYPA/AMBNT/LAKE

11EPALES 751216 04001002
0031 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/30	14 00	0000	9.7	11.4	15	100	9.40	76	0.040	0.700	0.080	0.035
	14 00	0003	9.7			100	9.40					
	14 00	0006	9.7	11.3		100	9.30	76	0.040	0.500	0.070	0.034
	14 00	0010	9.4			100	8.90					
	14 00	0016	7.0	8.4		100	8.80	82	0.050	0.600	0.140	0.042
	14 00	0025	6.0	8.3		100	9.10	76	0.060	0.800	0.160	0.042
75/08/01	14 20	0000	22.4	10.6	6	13	8.70	76	0.070	3.200	0.020K	0.224
	14 20	0009	18.7	7.0		12	8.75	80	0.040	0.800	0.020K	0.024
	14 20	0015	16.5	6.0		12	8.40	78	0.740	0.900	0.230	0.028
75/11/06	13 20	0000	6.0	7.2		184	7.50	79	0.220	0.800	0.300	0.080
	13 20	0005	6.0	7.2		184	7.50	80	0.290	0.800	0.230	0.082
	13 20	0015	6.0	7.0		184	7.50	81	0.230	0.800	0.220	0.082

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT RFMNING PERCENT
75/05/30	14 00	0000	0.111		
	14 00	0006	0.105		
	14 00	0016	0.129		
	14 00	0025	0.202		
75/08/01	14 20	0000	0.514	387.2	
	14 20	0009	0.068		
	14 20	0015	0.104		
75/11/06	13 20	0000	0.137	4.2	
	13 20	0005	0.132		
	13 20	0015	0.134		

K VALUE KNOWN TO BE LESS
THAN INDICATED

APPENDIX D

TRIBUTARY AND WASTEWATER TREATMENT PLANT DATA

[illegible] RETRIEVAL DATE 77/01/22
DATA DOCUMENTATION SURVEY
PAGE LAS VEGAS

/TYPE/ASSIST/STORAGE

320481
41 41 15.0 115 50 40.0 4
OLYMPIC RIVER
32 15 WILD HORSE
O/WILD HORSE RESERVOIR 130792
RNK SAM 100 FT FRM HWY 93 NW TIP OF PES
11EPALES 04001004
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/24	12 20		0.092	1.350	0.174	0.087	0.120
74/12/13	12 45		0.080	1.500	0.133	0.045	0.080
75/01/15	12 00		0.024	2.250	0.650	0.187	0.630
75/02/22	11 00		0.005	4.300	2.000	0.195	1.850
75/03/22	11 40		0.005	4.600	2.400	0.180	2.700
75/04/13	15 00		0.035	3.450	1.050	0.155	0.920
75/04/28	15 00		0.270	1.500	0.400	0.135	0.280
75/05/12	15 00		0.300	1.550	0.130	0.110	0.230
75/05/24	15 00		0.220	1.630	0.180	0.080	0.130
75/06/07			0.020	1.075	0.135	0.145	0.175
75/06/22	12 00		0.080	0.900	0.120	0.055	0.100
75/07/20	11 00		0.200	1.450	0.160	0.165	0.210
75/08/17	11 00		0.070	1.100	0.110	0.130	0.180
75/09/13	11 35		0.020	0.900	0.240	0.165	0.220
75/10/12	12 08		0.090	1.800	0.140	0.070	0.110

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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

41 38 40.0 115 47 30.0 4
DUBOIS RIVER
32 15 WILD HORSE
T/WILD HORSE RESERVOIR 1401742
0400 DU MAY 43 1 MI S OF WILD HORSE
11ERVALES 04001004
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/24	10 55		0.015	1.100	0.035	0.070	0.070
74/12/13	11 35		1.024	1.600	0.060	0.070	0.130
75/01/18	10 40		0.084	0.700	0.032	0.075	0.110
75/02/22	10 35		0.105	0.500	0.030	0.085	0.140
75/03/22	10 46		0.075	0.950	0.070	0.115	0.140
75/04/13	15 30		0.010	2.800	0.045	0.040	0.340
75/04/28	15 30		0.115	2.300	0.170	0.135	0.210
75/05/12	15 31		0.015	1.450	0.040	0.140	0.200
75/05/24	15 30		0.010	1.500	0.040	0.105	0.160
75/06/07			0.040	0.450	0.030	0.045	0.060
75/06/22	17 30		0.045	1.750	0.155	0.050	0.160
75/07/20	10 10		0.015	1.250	0.045	0.155	0.190
75/08/17	10 30		0.015	0.350	0.020	0.080	0.110
75/09/13	10 45		0.020	1.500	0.030	0.140	0.260
75/10/12	11 02		0.015	0.500	0.025	0.095	0.080

[illegible] RETRIEVAL DATE=77/01/27
NATL EUTROPHICATION SURVEY
FROM LAS VEGAS

320901
41 37 05.0 115 51 35.0 4
DEER CREEK
32 15 WILD HORSE
T/WILD HORSE RESERVOIR 130792
BRDG ON DRT RD 5.5 MI S# OF WILD HORSE
11FPALES 04001004
0000 FEET DEPTH CLASS 00

/IN-A/A-MGT/STRET

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/05/24	16 00		0.010	2.800	0.060	0.040	0.060
75/06/07			0.015	1.100	0.025	0.080	0.090
75/06/22	18 30		0.010	0.750	0.030	0.060	0.100
75/07/20	09 50		0.015	1.450	0.030	0.040	0.130
75/08/17	10 15		0.005	0.200	0.005	0.035	0.050

D.W.

[illegible]
[illegible] LAS VEGAS

[illegible]

320401
41 40 50.0 115 46 50.0 4
PENROD CREEK
32 15 WILD HORSE
T/WILD HORSE RESERVOIR 130742
BRDG ON DRT RD 3.3 MI NE
ELKO
TIEPALES 04001004
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/24	11 25		0.003	1.100	0.045	0.020	0.050
74/12/13	11 50		0.080	1.400	0.035	0.045	0.080
75/03/22	11 00		0.045	0.300	0.015	0.030	0.070
75/04/14	15 45		0.015	0.850	0.020	0.100	0.130
75/04/28	15 15		0.250	0.800	0.045	0.035	0.070
75/05/12	15 15		0.130	1.750	0.250	0.065	0.140
75/05/24	15 15		0.025	1.650	0.030	0.050	0.090
75/06/07			0.030	0.500	0.020	0.060	0.080
75/06/22	14 00		0.030	1.100	0.025	0.035	0.070
75/07/30	10 20		0.010	0.850	0.025	0.070	0.100
75/08/17	10 45		0.005	0.250	0.005	0.050	0.090
75/09/13	10 55		0.020	0.700	0.010	0.070	0.100
75/10/12	11 17		0.005	1.100	0.015	0.055	0.060

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APPENDIX E

PARAMETRIC RANKINGS OF LAKES
SAMPLED BY NES IN 1975

STATE OF NEVADA

Mean or median values for six of the key parameters evaluated in establishing the trophic conditions of Nevada lakes sampled are presented to allow direct comparison of the ranking, by parameter, of each lake relative to the others. Median total phosphorus, median inorganic nitrogen and median dissolved orthophosphorus levels are expressed in mg/l. Chlorophyll a values are expressed in µg/l. To maintain consistent rank order with the preceding parameters, the mean Secchi disc depth, in inches, is subtracted from 500. Similarly, minimum dissolved oxygen values are subtracted from 15 to create table entries.

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	16-MIN DO	MEDIAN DISS-ORTHO P
3201	LAKE MEAD	0.016	0.340	266.565	3.111	11.400	0.005
3202	LAHONTAN RESERVOIR	0.198	0.350	472.003	4.608	10.400	0.148
3204	RYE PATCH RESERVOIR	0.094	0.050	467.750	4.933	10.000	0.039
3205	LAKE TAHOE	0.005	0.040	-3.269	0.571	10.200	0.000
3206	TOPAZ RESERVOIR	0.057	0.165	376.000	7.517	14.600	0.041
3207	UPPER PAHRANGAT LAKE	0.173	0.125	470.000	---	8.600	0.026
3208	WASHOE LAKE	0.403	0.130	494.555	11.633	7.200	0.268
3209	WILD HORSE RESERVOIR	0.114	0.320	439.400	75.530	14.600	0.065
3210	WILSON RESERVOIR	0.049	0.120	197.333	10.033	11.400	0.016
3211	WALKER LAKE	0.602	0.030	405.333	3.422	15.000	0.574

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3201	LAKE MEAD	89 (8)	11 (1)	78 (7)	88 (7)	39 (3)	89 (8)
3202	LAHONTAN RESERVOIR	22 (2)	0 (0)	22 (2)	63 (5)	56 (5)	22 (2)
3204	RYE PATCH RESERVOIR	56 (5)	89 (8)	44 (4)	50 (4)	78 (7)	56 (5)
3205	LAKE TAHOE	100 (9)	100 (9)	100 (9)	100 (8)	67 (6)	100 (9)
3206	TOPAZ RESERVOIR	67 (6)	33 (3)	67 (6)	38 (3)	17 (1)	44 (4)
3207	UPPER PAHRANAGAT LAKE	33 (3)	56 (5)	33 (3)	---	89 (8)	67 (6)
3208	WASHOE LAKE	11 (1)	44 (4)	0 (0)	13 (1)	100 (9)	11 (1)
3209	WILD HORSE RESERVOIR	44 (4)	22 (2)	11 (1)	0 (0)	17 (1)	33 (3)
3210	WILSON RESERVOIR	78 (7)	67 (6)	89 (8)	25 (2)	39 (3)	78 (7)
3211	WALKER LAKE	0 (0)	78 (7)	56 (5)	75 (6)	0 (0)	0 (0)

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